Process and apparatus for producing coated portions of woven fabric

Field of the Invention

This invention concerns a process for producing individual portions of woven fabric coated with a flowable coating composition.

Background of the Invention

Coated portions of woven fabric are used for example, but not exclusively, in the production of airbags for airbag systems. These airbags consist in general of a plurality of individual portions which after they have been produced, namely cut to size and coated, have to be joined together. The individual portions are produced from a woven fabric coated with silicone rubber because of a need for strength, heat resistance, gas impermeability and desired properties of elasticity.

It is known within the assignee company to produce these individual portions of the airbag by proceeding from a reel of wound-up web of woven fabric, the web being continuously unreeled and processed. A horizontally guided section of the web of woven fabric is coated on its topside, over its entire width, with a silicone rubber which is flowable in its original state and which, after smoothing by means of a squeegee, is subjected to heating/vulcanization. The individual portions needed to produce the airbag are subsequently cut out of the coated vulcanized woven fabric using a laser-cutting range for example, while the remaining areal sections of the coated woven fabric are disposed of as scrap. The coated individual portions are subsequently joined together to produce the airbag. A fundamentally similar process, wherein a woven fabric is initially completely coated in a first step and subsequently the portions needed to produce an airbag of an airbag system are cut out of the area of the woven fabric, is known for example from US 2004/0029468 A1.

Silicone or silicone rubber is a comparatively costly starting material. This fact is particularly disadvantageous in relation to the above-described method of operation, since such products are produced in large amounts and the resulting fraction of scrap generally accounts for about 20% by weight to 30% by weight of the coated woven fabric. The operation thus produces considerable amounts of scrap which is difficult to dispose of and

possibly re-use because it constitutes a heterogeneous composition of matter.

DE 40 28 637 A1 discloses a process for partial coating of woven fabrics which are designed as portions of an airbag system. The products desired here are portions of woven fabric which are partially coated and which are subsequently sewn together for the purpose of forming an airbag. The merely partial coating is designed to achieve enhanced air permeability in the uncoated regions compared with the coated regions. In addition, the coating is said to improve the processibility of the woven fabric, in particular the cutting of the woven fabric, so that there is always coating present along the edges of the portions mentioned. The disposal problem mentioned at the beginning, which arises when the woven fabric is uniformly coated, after the individual portions needed are cut out and the remaining portions are discarded, arises only to a very limited extent in this known process.

A comparable process wherein again in a first step a woven fabric is selectively coated and subsequently the portions needed to produce an airbag system are cut out of this coated fabric is also known from US 5 538 280. Here, coating is provided particularly in areas where cutting takes place. Again, the object is not whole-area coating, but merely partial coating in order that in this way the global air permeability of the portion may be set.

An airbag occasionally utilizes different woven fabric styles and/or woven fabrics of different silicone weight. The known process, however, provides scarcely any real opportunity for the silicone weight to be varied according to the individual portion. Waste is thus generally generated that differs in the type of the woven fabric and with regard to the silicone weight.

US 5 110 666 discloses a further process for producing woven fabric portions of an airbag system wherein selective coating of woven fabric portions is provided. The process is designed to be continuous, and a woven fabric web unwound off a feed reel is coated, on one side at least, with a uniform sequence of individual coating patterns, which after passing through a curing oven are subsequently wound up again. To obtain woven

fabric portions directly useful for producing an airbag system, uniform longitudinal sections are cut off the wound-up woven fabric web bearing the areal patterns, and are subsequently cut to size according to the contours of the woven fabric portions to be produced.

Summary of the Invention

Against this background, it is an object of the present invention to develop a process of the type identified at the beginning in the direction of improved scope for varying the product, a reduction in the amount of waste generated and also a homogenization in the waste generated and a simple implementation.

We have found that this object is achieved for such a process by cutting out individual portions of woven fabric and discarding the remaining residual portions, placing the individual portions on a support underneath a sieve such that they are situated underneath areal fractions of the sieve, and applying a coating composition to the individual portions to be coated.

It is accordingly essential to the present invention that, in departure from the prior art discussed at the beginning, the woven fabric web is only coated with a coating composition according to the sheetlike extent of the individual portions cut out of the woven fabric web. As a result, scrap is only generated in the form of uncoated woven fabric, considerably simplifying any disposal engineering. Material is saved with regard to coating composition in accordance with the costs for the coating composition and also for the scrap quantity which is geometrically dictated with regard to the area of the woven fabric web. Variations become realizable in the coating weight for the individual portions in accordance with the properties desired for the coated individual portions in that the coating thickness itself can be individually varied for each individual portion. As a consequence of the homogeneity of the scrap, there is no need for separating operations for recovering individual, in particular utilizable, components.

To realize the coating the conventional screen printing process is used. Any version of the screen printing process can in principle be used, including flat screen printing, cylinder screen printing, rotary screen printing

or else electrostatic screen printing, to mention but a few examples. What is essential in all cases is that a screen comprises areal fractions which are permeable and impermeable to the coating composition and whose size, shape and position is conformed to the individual portions to be coated and to be cut out of the woven fabric web, so that the coating composition only arrives on the individual portions through the permeable areal fractions. There is thus no generation of coated scrap.

Additional features are directed to an advantageous use of the process of the present invention, namely for producing the silicone-coated individual portions of the airbag of an airbag system, which are subsequently joined together in a conventional manner to produce the airbag. If necessary, individual portions comprising woven fabric having differing coating weights can be produced in a simple manner. In principle, hot- and cold-vulcanizing silicones can be used, in particular with regard to their high heat resistance, flame protection and also their elasticity which is substantially constant over a wide temperature range.

Advantageously, this process is utilized in accordance with the present invention for producing the individual portions of the airbag of an airbag system which consist of a silicone-coated woven fabric.

The present invention further has for its object to provide apparatus for carrying out this process of the present invention. We have found that this object is achieved in relation to such a process by the consecutive arrangement, in the direction of material flow, of a cutting station, adapted for cutting to size individual portions out of woven fabric and for discarding residual portions of the woven fabric, a coating station for transferring a coating composition to the individual portions, and a heating station for treating the coating composition.

The apparatus thereby consists of the consecutive arrangement of a cutting station, a coating station and a heating station, which are connected with each other via conveying systems. The apparatus can be designed for continuous operation whose starting materials consists of coated portions of woven fabric and uncoated portions of woven fabric to be regarded as waste. The apparatus offers cost advantages through the possibility of

saving coating material and through the simpler handling of the waste generated substantially in terms of material. The apparatus further offers technical advantages with regard to the simple coating thickness individually conformed to the individual portion to be coated.

Brief Description of the Drawings

The present invention will now be more particularly elucidated with regard to the illustrated process flow scheme for producing the airbag of an airbag system in the drawings, where:

Fig. 1 shows the cutting to size of the individual portions of an airbag in the original state;

Fig. 2 shows the siliconizing of the woven fabric;

Fig. 3 shows the drying of the coated fabric;

Fig. 4 shows a representation of the ready-produced individual portions to be joined together to produce an airbag.

Detailed Description of the Invention

The starting point for the process of the present invention is shown in fig. 1 to be a web moving horizontally in the direction of arrow 1, uniformly or else cyclically, preferably in a cutting station 1', which consists of a woven fabric 2 and is being unwound off a reel not shown. The forward feed for the web can be provided in any desired manner in engineering terms, and will not be more particularly discussed hereinbelow.

A cutting apparatus 3, for example a laser-cutting apparatus, cuts out of the plane of the web individual portions 4, 5, 6 whose contours and other constitution correspond to the individual portions of the airbag which are to be joined together.

In a subsequent step, still within the cutting station 1', the individual portions 4, 5, 6 are separated from the remaining portions 7 of the woven fabric 2, and the latter are discarded as waste. The individual portions 4, 5,

6 subsequently pass into a coating station 8, depicted schematically in fig. 2, for applying a silicone layer.

This coating station 8 is fitted out according to the functional principle, known from printing technology, of the screen printing process. The individual portions 4, 5, 6 resting at defined positions on a planar horizontal support 9 have placed on them a finely meshed sieve onto which is applied silicone rubber in flowable or brushable consistency and smoothed by means of a squeegee 10. The constitution of the sieve is such that it comprises areal fractions, through which the silicone rubber passes, and such areal fractions as are covered up or stopped, so that no silicone rubber can pass through.

The individual portions 4, 5, 6 are positioned on the support 9 such that the permeable areal fractions of the sieve are situated above these individual portions. The permeable areal fractions are conformed to the specified individual portions with regard to the area and also geometrically. The mesh size of the sieve and the viscosity of the silicone rubber as coating composition are chosen to the effect that this composition is pressed through the permeable areal fractions and depicts them geometrically on the individual portions.

The exit product of coating station 8 is thus individual portions 4, 5, 6 coated with a layer of silicone rubber. These are subsequently fed, for crosslinking or drying, to a heating station 11 depicted schematically in fig. 3. The coated individual portions rest on a support 12 above which a heating appliance 13 is situated. A crosslinking reaction ensues in accordance with the type of silicone used.

The exit products of heating station 11 are the ready-produced individual portions 4', 5', 6' which are shown in fig. 4 in their contours by way of example and which thus consist of a silicone-coated woven fabric, and these individual portions are subsequently joined together in a conventional manner to produce the airbag.

The cutting station (1'), the coating station (8) and also the heating station each form stages of a unitary process which are connected to each other via conveying systems not depicted.